e. **i.** Because $0.\overline{32}$ has two digits that repeat to the right of the decimal point, multiply by 100.

Let $F = 0.\overline{32} = 0.323232\ldots$.
Then $100F = 32.323232\ldots$.
So $100F - F = 32.323232\ldots -$
$0.323232\ldots = 32$. Therefore, $99F = 32$,
so $F = \frac{32}{99}$.

ii. Because $0.\overline{325}$ has three digits that repeat to the right of the decimal point, multiply by 1000.

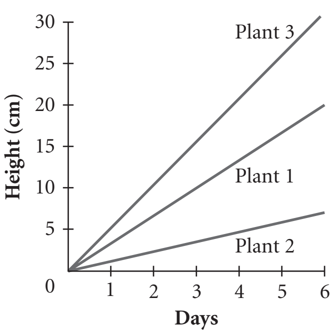
Let $F = 0.\overline{325} = 0.325325325\ldots$.
Then $1000F = 325.325325325\ldots$.
So $1000F - F = 325.325325325\ldots -$
$0.325325325\ldots = 325$.
Therefore, $999F = 325$, so $F = \frac{325}{999}$.

iii. Because $0.2\overline{325}$ has four digits to the right of the decimal point before the digits start to repeat, multiply by 10,000.

Let $F = 0.2\overline{325} = 0.2325325325\ldots$. Then $10{,}000F = 2325.325325325\ldots$. Because the first digit in the decimal form of F does not repeat, subtract $10F = 2.325325325\ldots$ rather than F in order to match up the decimal parts. $10{,}000F - 10F = 2325.325325325\ldots -$ $2.325325325\ldots = 2323$. Therefore, $9990F = 325$, so $F = \frac{2323}{9990}$.

Improving Your Reasoning Skills

The plants are not growing at the same rate. Plant 1 is growing at a rate of $20 \div 6$, or about 3.3 cm per day. Plant 2 is growing at a rate of $7 \div 6$, or about 1.2 cm per day. Plant 3 is growing at a rate of $30 \div 6$, or 5 cm per day.



CHAPTER 4

LESSON 4.1

Exercises

1. The order of subtraction may vary.

a. $\frac{5-1}{3-1} = \frac{4}{2} = 2$ **b.** $\frac{5-3}{4-1} = \frac{2}{3}$

c. $\frac{6-2}{1-4} = \frac{4}{-3} = -\frac{4}{3}$

2. a. $Slope = \frac{change\ in\ y}{change\ in\ x} = \frac{7-4}{4-2} = \frac{3}{2} = 1.5$. To find another point on the line, start with a known point and add *change in x* to the x-coordinate and *change in y* to the y-coordinate. For example, if you start with (4, 7), you get $(4 + change\ in\ x,$ $7 + change\ in\ y) = (4+2, 7+3) = (6, 10)$. So, (6, 10) is on the line.

b. $Slope = \frac{change\ in\ y}{change\ in\ x} = \frac{5-(-1)}{2-6} = \frac{6}{-4} = \frac{3}{-2} = -1.5$. Starting with $(6, -1)$, another point on the line is $(6 + change\ in\ x, -1 + change\ in\ y)$ $= (6 + -2, -1 + 3) = (4, 2)$.

c. $Slope = \frac{change\ in\ y}{change\ in\ x} = \frac{4-4}{8-(-2)} = 0$. The line is a horizontal line through $y = 4$, so any point with a y-coordinate of 4 is on the line.

d. $Slope = \frac{12-(-3)}{9-1} = \frac{15}{8} = 1.875$. Points will vary. One possible point is (17, 27).

3. a. One way to find other points on the line is to start with (0, 4) and repeatedly add 1 (the change in x) to the x-coordinate and 3 (the change in y) to the y-coordinate. Or, because $\frac{3}{1} = \frac{-3}{-1}$, you can add -1 to the x-coordinate and -3 to the y-coordinate. Two possible points are (1, 7) and $(-1, 1)$. Checks: The slope between (0, 4) and (1, 7) is $\frac{7-4}{1-0} = \frac{3}{1}$, or 3. The slope between (0, 4) and $(-1, 1)$ is $\frac{1-4}{-1-0} = \frac{-3}{-1} = \frac{3}{1}$, or 3.

b. One way to find other points on the line is to start with (2, 8) and repeatedly add 1 to the x-coordinate and -5 to the y-coordinate. Or, because $-5 = \frac{5}{-1}$, you can also add -1 to the x-coordinate and 5 to the y-coordinate. Two possible points are (3, 3) and (1, 13). Checks: The slope between (2, 8) and (3, 3) is $\frac{3-8}{3-2} = \frac{-5}{1}$, or -5. The slope between (2, 8)and (1, 13) is $\frac{13-8}{1-2} = \frac{5}{-1}$, or -5.

c. Sample answer: (12, 3), (4, 9)
Checks: $\frac{3-6}{12-8} = \frac{-3}{4} = -\frac{3}{4}$ and $\frac{9-6}{4-8} = \frac{3}{-4} = -\frac{3}{4}$

d. Sample answer: (6, 7.2), (4, 6.8)
Checks: $\frac{7.2-7}{6-5} = \frac{0.2}{1} = 0.2$ and $\frac{6.8-7}{4-5} = \frac{-0.2}{-1} = 0.2$

4. Answers will vary.

5. a. **i.** The x-values don't change, so the slope is undefined.

ii. The y-values decrease as the x-values increase, so the slope is negative.

iii. The y-values don't change, so the slope is 0.

iv. The y-values increase as the x-values increase, so the slope is positive.

b. **i.** Using the points (4, 0) and (4, 3), we find the slope to be $\frac{3-0}{4-4} = \frac{3}{0}$. Because you can't divide by 0, the slope is undefined. Check: Using $(4, -8)$ and (4, 20), the slope is $\frac{20-(-8)}{4-4} = \frac{28}{0}$, which is undefined.

ii. Using the points (1, 3) and $(4, -3)$, we find the slope to be $\frac{-3-3}{4-1} = \frac{-6}{3} = -2$. Check: Using (0, 5) and $(3, -1)$, the slope is $\frac{-1-5}{3-0} = \frac{-6}{3} = -2$.

iii. Using the points $(-4, -5)$ and $(-3, -5)$, we find the slope to be $\frac{-5-(-5)}{-3-(-4)} = \frac{-5+5}{-3+4} = \frac{0}{1} = 0$. Check: Using $(1, -5)$ and $(4, -5)$, the slope is $\frac{-5-(-5)}{4-1} = \frac{0}{3} = 0$.

iv. Using the points $(0, -2)$ and (4, 1), we find the slope to be $\frac{1-(-2)}{4-0} = \frac{3}{4}$. Check: Using $(-4, -5)$ and $(-2, -3.5)$, the slope is $\frac{-3.5-(-5)}{-2-(-4)} = \frac{1.5}{2} = \frac{3}{4}$.

c. **i.** $x = 4$

ii. $y = 5 - 2x$

iii. $y = -5$

iv. $y = -2 + \frac{3}{4}x$

6. a. The lines are parallel, so they have the same slope. The y-intercepts are different.

b. Line b matches the equation because it has a y-intercept of -3.

c. Line a has a y-intercept of 1 and a slope of $\frac{2}{5}$, so its equation is $y = 1 + \frac{2}{5}x$.

d. The slope, $\frac{2}{5}$, is the same in each equation. The y-intercepts, -3 and 1, are different.

7. a. Use the slope to move backward from (40, 16.55); $(40 - 10, 16.55 - 0.29 \cdot 10) = (30, 13.65)$, or \$13.65 for 30 h; $(30 - 10, 13.75 - 0.29 \cdot 10) = (20, 10.75)$, or \$10.75 for 20 h.

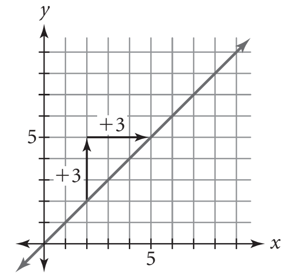
b. Continuing the process in 7a leads to (0, 4.95), or \$4.95 for 0 h. This is the flat monthly rate for Hector's Internet service.

c. $y = 4.95 + 0.29x$, where x is time in hours and y is total fee in dollars

d. Substitute 280 for x and solve for y: $y = 4.95 + 0.29(280) = 86.15$. \$86.15 for 280 h.

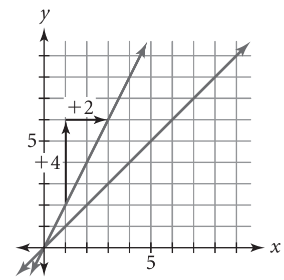
8. Because the line decreases from left to right, the slope is $-\frac{a}{c}$. The y-intercept is e. So the equation is $y = e - \frac{a}{c}x$, $y = e + \frac{-a}{c}x$, or $y = e + \frac{a}{-c}x$.

9. a. Slope triangles will vary. Here is one example:



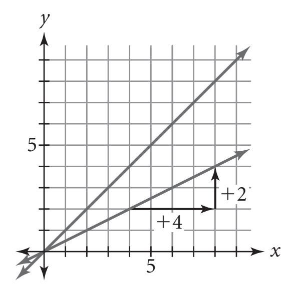
The change in y and the change in x are the same for any slope triangle.

b. Lines will vary. Here is one example:



For a steeper line, the change in y is greater than the change in x. Numerically, the slope is greater than 1.

c. Lines will vary. Here is one example:



For a less steep line, the change in x is greater than the change in y. Numerically, the slope is between 0 and 1.

d. The line would decrease from left to right because the slope is negative. The line would be very steep because 15 is significantly greater than 1.

10. a. The slope between any two points is 30.

b. m/min; the slope, 30, is the number of meters the balloon rises every minute.

c. The y-intercept (the height of the balloon at 0 minutes) is 14 and the slope is 30, so the equation is $y = 14 + 30x$.

d. Substitute 8 for x:
$y = 14 + 30(8) = 14 + 240 = 254$. After 8 min, the balloon will be 254 m high.

e. Solve $500 = 14 + 30x$ to find the time when the balloon reaches 500 m:

$$500 = 14 + 30x$$
$$500 - 14 = 14 - 14 + 30x$$
$$486 = 30x$$
$$\frac{486}{30} = \frac{30x}{30}$$
$$16.2 = x$$

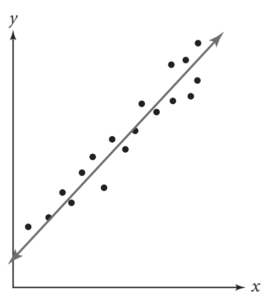
The balloon reaches 500 m in 16.2 min, so it is at a height of 500 m or less between 0 and 16.2 min.

11. a. i. Line 2 is a better choice. A majority of points are closer to line 2 than to line 1.

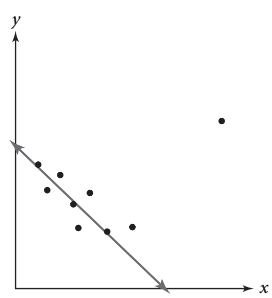
ii. Line 4 is a better choice. Line 3 passes through or is close to a number of points, but there are too many points above this line and too few below it. Even though line 4 does not intercept any points, it is the better choice because there are about the same number of points above it as below it.

b. Answers will vary but should show the general direction of the points and have about as many points above the line as below it. Sample answers:

i.



ii.



c. Answers will vary. The line should reflect the direction of the data, and about the same number of points should be above the line as below it.

12. a. Use the formula for the area of a triangle, $A = 0.5bh$, with $b = 18.3$ and $h = 7.4$: $A = 0.5(18.3)(7.4) = 67.7\text{ cm}^2$.

b. Use $b = 18.3 - 0.1 = 18.2$ and $h = 7.4 - 0.1 = 7.3$: $A = 0.5(18.2)(7.3) = 66.4\text{ cm}^2$.

c. Use $b = 18.3 + 0.1 = 18.4$ and $h = 7.4 + 0.1 = 7.5$: $A = 0.5(18.4)(7.5) = 69.0\text{ cm}^2$.

d. $67.7 \pm 1.3\text{ cm}^2$

13. Answers will vary. The sum of the ages must be 50, and the middle value must be 6. One possible set of ages is {3, 3, 6, 16, 22}. Other sets are possible.

14. a. $L_2 = 2.5(L_1 + 14)$; {27.5, 32.5, 40, 55, 60}

b. $L_3 = \frac{(L_2 - 35)}{2.5}$, or $L_3 = \frac{L_2}{2.5} - 14$

15. a. 85% **b.** 150% **c.** 6.5% **d.** 107%

16. 3. Combine like terms.

4. Subtract 3 from both sides.

6. Divide both sides by 5.

LESSON 4.2

EXERCISES

1. a. No; although this line goes through four points, too many points are below the line.

b. No; although the slope of the line shows the general direction of the data, too many points are below the line.

c. Yes; about the same number of points is above the line as below the line, and the slope of the line shows the general direction of the data.

d. No; although the same number of points is above and below the line, the slope of the line doesn't show the direction of the data very well.

2. Vertical; $x = 2$

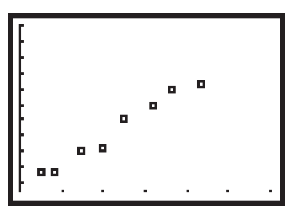
3. a. $y = -2 + \frac{2}{3}x$

b. $y = 2 - \frac{2}{3}x$

c. $x = -3$

d. $y = 3$

4. a. There is a linear pattern.

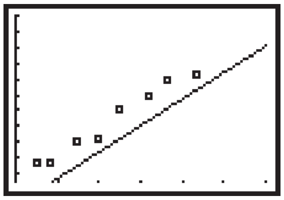


[0, 36, 6, 120, 1200, 100]

b. Answers will vary. Using the points (8, 376) and (19, 684), the slope is 28.

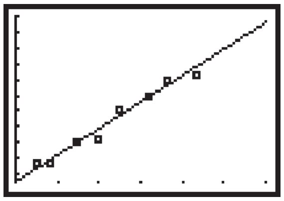
c. The slope represents the number of quarters Penny saves per month.

d. $y = 28x$; the line needs to move up (the y-intercept needs to increase).



[0, 36, 6, 150, 1200, 50]

e. Answers will vary. A possible equation is $y = 152 + 28x$.

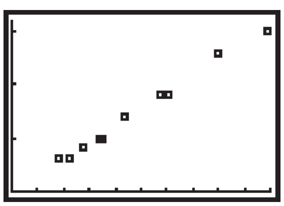


f. The y-intercept represents the number of quarters Penny's grandmother gave her.

g. Answers depend on the line students find. On her 18th birthday, Penny will have been saving for 36 months. Using the equation $y = 152 + 28x$, she will have $152 + 28(36)$, or 1160 quarters. The prediction may not be reliable because it extrapolates 10 months beyond the data.

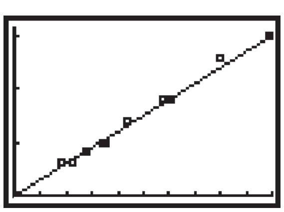
5. a. The number of representatives depends on the population.

b. Let x represent the population in millions, and let y represent the number of representatives.



[0, 10, 1, 0, 16, 5]

c. Answers will vary. Two possible points are (2.8, 4) and (6.1, 9). The slope between these points is approximately 1.5. The equation $y = 1.5x$ appears to fit the data with a y-intercept of 0. The slope represents the number of representatives per 1 million people. The y-intercept means that a state with no population would have no representatives.



[0, 10, 1, 0, 16, 5]

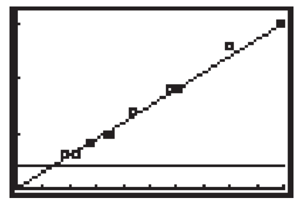
d. The equation $y = 1.5x$ gives $y = 1.5(33.9) = 50.85$, or 51 representatives. (For 2001–2010, California actually has 53 representatives.)

e. The equation $y = 1.5x$ gives $8 = 1.5x$; $x = \frac{8}{1.5} \approx 5.3$; about 5.3 million. (The estimated population of Minnesota in the 2000 census was 4.9 million.)

f. A direct variation is a reasonable model because a state with no population would have no representatives, so the line should go through the origin.

6. a. No; each state has two senators regardless of its population.

b. $y = 2$, where x represents population in millions and y represents the number of senators



c. The graph is a horizontal line because there's no change in y, the number of senators, as x, the state population, changes.

7. a. Slope $= \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{4.4 - 3.4}{4.5 - 2} = 0.4$ m/s

b. 2.6 m. Possible explanation: As the time decreases by 1 s, the distance decreases by 0.4 m. So after 1 s she is $3.4 - 0.4$, or 3 m away, and after 0 s she is $3 - 0.4$, or 2.6 m away.

c. $y = 2.6 + 0.4x$

8. a. The slope is negative because the distance decreases as the time increases.

b. The y-intercept represents the start distance for the walk. The x-intercept represents the elapsed time when the walker reaches the sensor.

c. Answers will vary. Quadrant II could indicate walking before you started timing. Quadrant IV could indicate that the walker walks past you (the distances behind you are considered negative).

9. a. Answers will vary. Sample answer: $y = -8 + 4x$

b. Answers will vary. Sample answer: $y = -2x$

c. $y = 6 + x$ **d.** $y = 10$

10. a. All the lines have a slope of 3, so they are all parallel.

b. All the lines cross the y-axis at 5 (excluding the y-axis itself); they radiate around the point (0, 5).

c. All the lines are parallel to the x-axis, or horizontal.

d. All the lines are parallel to the y-axis, or vertical.

11. a. Neither; the x- and y-values do not have a constant product or a constant ratio.

b. Inverse variation; the x- and y-values have a constant product. The equation is $y = \frac{100}{x}$.

c. Direct variation; the x- and y-values have a constant ratio. The equation is $y = -2.5x$.

d. Direct variation; the x- and y-values have a constant ratio. The equation is $y = \frac{1}{13}x$.

12. a.
$$8 - 12m = 17$$
$$-12m = 9$$
$$m = -0.75$$

b.
$$2r + 7 = -24$$
$$2r = -31$$
$$r = -15.5$$

c.
$$-6 - 3w = 42$$
$$-3w = 48$$
$$w = -16$$

13. a. Mean: $24.8\overline{6}$; median: 21

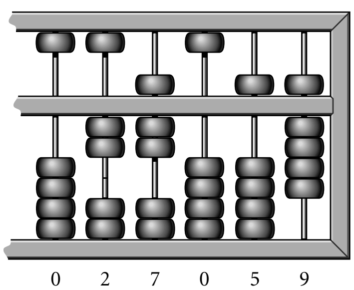
b. Mean: 44.5; median: 40

c. Mean: approximately 140.1; median: 145

d. Mean: 85.75; median: 86.5

IMPROVING YOUR VISUAL THINKING SKILLS

The second abacus shows 84. The third shows 71,545. 27,059 would look like this:



LESSON 4.3

EXERCISES

1. a. The equation $y = 3 + 4(x - 5)$ is in point-slope form $y = y_1 + m(x - x_1)$, where m is the slope and (x_1, y_1) is a point on the line. So the slope is 4, and (5, 3) is a point on the line.

b. Slope 2; point $(-3.1, 1.9)$

c. Slope -3.47; point $(7, -2)$

d. Slope -1.38; point $(2.5, 5)$

2. a. Point-slope form is $y = y_1 + m(x - x_1)$, where m is the slope and (x_1, y_1) is the point. Using slope 3 and point (2, 5), we get the equation $y = 5 + 3(x - 2)$.

b. $y = -4 - 5(x - 1)$

3. a. $\frac{13 - (-1)}{5 - (-2)} = \frac{14}{7} = 2$

b. $y = -1 + 2(x + 2)$

c. $y = 13 + 2(x - 5)$

d. The graphs coincide, and the tables are identical.

4. a. Any pair of points can be used to find the slope. Using the first two points in the table, $(5, -15)$ and $(10, -8.5)$, gives

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-8.5 - (-15)}{10 - 5} = \frac{6.5}{5} = 1.3.$$

The data are exactly linear, so any two points will give this slope.

b. Answers will vary. Using the point $(5, -15)$, the equation is $y = -15 + 1.3(x - 5)$.

c. Answers will vary. Using the point (20, 4.5), the equation is $y = 4.5 + 1.3(x - 20)$.

d. The two equations should give the same graph and table.

e. Substitute 0 for x in your equation from 4b or 4c and solve for y. Using the equation obtained in 4b, $y = -15 + 1.3(0 - 5) = -15 + 1.3(-5) = -15 - 6.5 = -21.5$. This means that when the actual temperature is 0°F with a wind speed of 20 mi/h, the wind chill temperature is -21.5°F. In the graph of this data, -21.5 is the y-intercept.

5. Answers will vary.

6. Segment a has slope 1. Two points on the segment are (0, 0.5) and (2, 2.5), so two possible equations are $y = 0.5 + 1(x - 0)$ and $y = 2.5 + 1(x - 2)$.

Segment b: $y = 2.5 - 0.75(x - 2)$ or $y = 1 - 0.75(x - 4)$

Segment c: $y = 1 + 1(x - 4)$ or $y = 3 + 1(x - 6)$

7. a. $\overline{AD}$: $y = 2 + 0.2(x + 1)$ or $y = 3 + 0.2(x - 4)$

$\overline{BC}$: $y = -2 + 0.2(x + 3)$ or $y = -1 + 0.2(x - 2)$

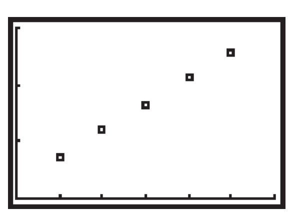
$\overline{AB}$: $y = 2 + 2(x + 1)$ or $y = -2 + 2(x + 3)$

$\overline{DC}$: $y = 3 + 2(x - 4)$ or $y = -1 + 2(x - 2)$

b. The slopes are the same; the coordinates of the points are different.

c. Quadrilateral $ABCD$ appears to be a parallelogram. In 7b, we found that $\overline{AD}$ and $\overline{BC}$ have the same slope, which means they are parallel. $\overline{AB}$ and $\overline{DC}$ both have slope 2, so they are also parallel.

8. a. The data appear linear.



[0, 6, 1, 0, 1.5, 0.5]

b. The slope, \$0.23 per ounce, is the cost for each additional ounce after the first.

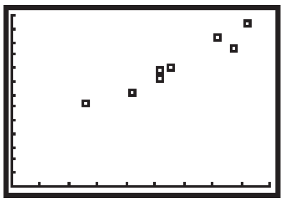
c. Answers will vary; Using the point (1, 0.37), we get the equation $y = 0.37 + 0.23(x - 1)$.

d. $y = 0.37 + 0.23(10 - 1) = 0.37 + 0.23(9)$
$= 0.37 + 2.07 = 2.44$. So the cost of mailing a 10 oz letter is \$2.44.

e. The rates are given for weights not exceeding the given weights, so a letter weighing 3.5 oz would cost the same as a 4 oz letter, or \$1.06. A letter weighing 9.1 oz would cost the same as a 10 oz letter, or \$2.44.

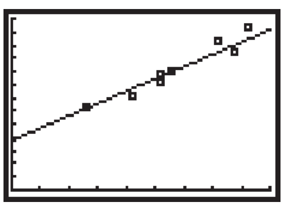
f. No; a continuous line includes points whose x-values are not whole numbers and whose y-values are not possible rates.

9. a. The data are approximately linear.



[0, 45, 5, 0, 650, 50]

b. Answers will vary. Using the points (28, 450) and (13, 310), the equation is $y = 310 + 9.3(x - 13)$.



[0, 45, 5, 0, 650, 50]

c. Substitute 41 for x in the equation obtained in 9b to obtain $y = 310 + 9.3(41 - 13) = 570.4$. This model predicts that a Hardee's Country Steak Biscuit has approximately 570 calories.

d. The actual data point lies above the line $y = 310 + 9.3(x - 13)$. If a point lies above the line, the sandwich has more calories than the model predicts.

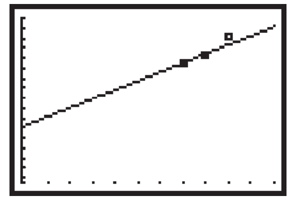
e. Answers will vary. Using $y = 310 + 9.3(x - 13)$ as a model, three points are above the line, two points are on the line, and three points are below the line.

f. Answers will vary. The line $y = 310 + 9.3(x - 13)$ appears to be a good fit.

g. Answers will vary. Using $y = 310 + 9.3(x - 13)$, a sandwich with 0 g of fat would have approximately 189 calories. This makes sense because not all calories in food come from fat.

10. a. $y = 205 + 1.8(x - 1990)$ or
$y = 214 + 1.8(x - 1995)$

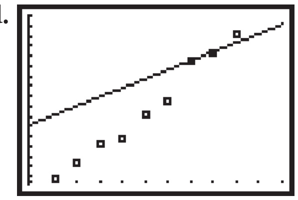
b. and **c.**



[1955, 2010, 5, 85, 250, 10]

The point (2000, 223) is somewhat close to the line, but the predicted value is too low.

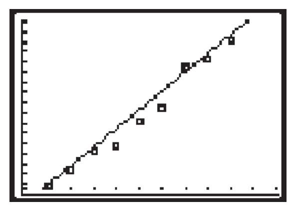
d.



[1955, 2010, 5, 85, 250, 10]

e. The data are generally linear, but the line doesn't fit them very well. A line with a steeper slope would be a better fit.

f. Answers will vary. The line $y = 200 + 3.7(x - 1990)$ gives a reasonable fit.



[1955, 2010, 5, 85, 250, 10]

g. Answers will vary depending on the equation chosen for 10f. Using $y = 200 + 3.7(x - 1990)$ gives an estimate of 274 million tons of trash in 2010.

11. a. Because volume and temperature are directly proportional, their ratio is constant. So $\frac{280}{3.5} = \frac{330}{x}$; $x = 4.125$, so the volume of gas is 4.125 L.

b. 180 K; you can find this by solving the proportion $\frac{280}{3.5} = \frac{x}{2.25}$.

12. a. The slope is -1. The change in x from the given point (3, 1) to $\left(5, \boxed{}\right)$ is 2. $\frac{\textit{Change in } y}{\textit{Change in } x} = -1$, so the change in y must be -2. The point is $(5, 1 - 2)$ or $(5, -1)$.

b. The slope is undefined. The line is vertical. So the x-coordinate of every point on the line is 2. The point is (2, 3).

c. The slope is $-\frac{5}{2}$. The change in y from the given point $(-2, 2)$ to $\left(\boxed{}, -3\right)$ is -5, so the change in x must be 2. The point is $(-2 + 2, -3)$ or $(0, -3)$.

13.

$4x + 3 = 2x + 7$	Original equation.
$4x - 2x + 3 = 2x - 2x + 7$	Subtract $2x$ from both sides.
$2x + 3 = 7$	Combine like terms.
$2x + 3 - 3 = 7 - 3$	Subtract 3 from both sides.
$2x = 4$	Combine like terms.
$\frac{2x}{2} = \frac{4}{2}$	Divide both sides by 2.
$x = 2$	Reduce.

LESSON 4.4

EXERCISES

1. a. Rewrite the first expression: $3 - 3(x + 4) = 3 - 3x - 12 = -3x - 9$. The expressions are not equivalent. The second expression needs to be changed to $-3x - 9$.

b. Rewrite the first expression: $5 + 2(x - 2) = 5 + 2x - 4 = 2x + 1$. The expressions are equivalent.

c. Rewrite the second expression: $2 + 5(x - 1) = 2 + 5x - 5 = 5x - 3$. The expressions are equivalent.

d. The second expression is equivalent to $-2x + 8$, so the expressions are not equivalent. You can change the second expression to $-2(x + 4)$ or $2(-x - 4)$.

2. a.

$y = 14 + 3(x - 5)$	Original equation.
$y = 14 + 3x - 15$	Distribute the 3.
$y = -1 + 3x$	Add.

b.

$y = -5 - 2(x + 5)$	Original equation.
$y = -5 - 2x - 10$	Distribute the -2.
$y = -15 - 2x$	Subtract.

c.

$6x + 2y = 24$	
$6x - 6x + 2y = 24 - 6x$	Subtract $6x$ from both sides.
$2y = 24 - 6x$	Subtract.
$\frac{2y}{2} = \frac{24 - 6x}{2}$	Divide both sides by 2.
$y = 12 - 3x$	Divide.

3. a.

$3x = 12$	Original equation.
$x = 4$	Division property.

b.

$-x - 45 = 47$	Original equation.
$-x = 92$	Addition property.
$x = -92$	Multiplication property.

c.

$x + 15 = 8$	Original equation.
$x = -7$	Subtraction property.

d.

$\frac{x}{4} = 28$	Original equation.
$x = 112$	Multiplication property.

4. a. $3(x - 2) = 3(x) + 3(-2) = 3x - 6$

b. $-4(x - 5) = -4(x) + (-4)(-5) = -4x + 20$

c. $-2(x + 8) = -2(x) + (-2)(8) = -2x - 16$

5. a. $(-5, 25)$

b. Solve the equation $15 = 25 - 2(x + 5)$:

$$15 = 25 - 2(x + 5)$$
$$-10 = -2(x + 5)$$
$$-10 = -2x - 10$$
$$0 = -2x$$
$$0 = x$$

6. a. Solve $y = 3(x + 8)$ for x. Two possible solutions are shown.

$y = 3(x + 8)$	Original equation.
$\frac{y}{3} = x + 8$	Divide by 3.
$\frac{y}{3} - 8 = x$, or $x = \frac{y}{3} - 8$	Subtract 8 from both sides.

$y = 3(x + 8)$	Original equation.
$y = 3x + 24$	Distributive property.
$y - 24 = 3x + 24 - 24$	Subtraction property (subtract 24 from both sides).
$y - 24 = 3x$	Combine like terms.
$\frac{y - 24}{3} = \frac{3x}{3}$	Division property (divide both sides by 3).
$\frac{y - 24}{3} = x$, or $x = \frac{y - 24}{3}$	Reduce.

b. Solve $\frac{y - 3}{x - 4} = 10$ for y.

$\frac{y - 3}{x - 4} = 10$	Original equation.
$y - 3 = 10(x - 4)$	Multiplication property (multiply both sides by $x - 4$).
$y = 3 + 10(x - 4)$,	Addition property (add 3 to both sides).
or $y = -37 + 10x$	Distributive property, reduce.

c. Solve $4(2y - 5) - 12 = x$ for y. Two possible solutions are shown.

$4(2y-5) - 12 = x$	Original equation.
$4(2y-5) = x + 12$	Addition property (add 12 to both sides).
$2y - 5 = \frac{x+12}{4}$	Division property (divide both sides by 4).
$2y = \frac{x+12}{4} + 5$	Addition property (add 5 to both sides).
$y = \dfrac{\frac{x+12}{4} + 5}{2}$, or $y = \frac{1}{8}x + 4$	Division property (divide both sides by 2).

$4(2y-5) - 12 = x$	Original equation.
$8y - 20 - 12 = x$	Distributive property.
$8y - 32 = x$	Combine like terms.
$8y = x + 32$	Addition property (add 32 to both sides).
$y = \frac{x+32}{8}$, or $y = \frac{1}{8}x + 4$	Division property (divide both sides by 8).

7. a. $3(x - 4)$ **b.** $-5(x - 4)$ **c.** $4(8 + x)$

d. $-7(x + 4)$

8. a. $y = 5(2 + x)$ **b.** $y = 5(x + 2)$

c. The y_1-value is missing, which means it is zero; $y = 0 + 5(x + 2)$.

d. $(-2, 0)$; this is the x-intercept.

9. a. Equations i and ii are equivalent. You can verify this by rewriting them in intercept form. Both equations are equivalent to $y = 24 - 2x$.

b. Equations i and iii are equivalent. Both are equivalent to $y = -5 + 4x$.

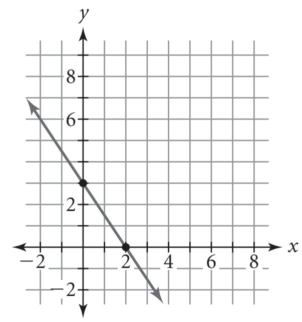
c. Equations ii and iii are equivalent. Both are equivalent to $y = 49 + 5x$.

d. Equations i and iii are equivalent. Both are equivalent to $y = 14 + 6x$.

10. a. $x = 2$; the point $(2, 0)$ is the x-intercept.

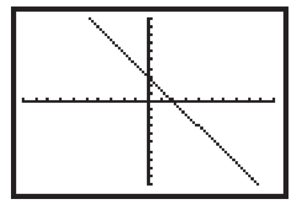
b. $y = 3$; the point $(0, 3)$ is the y-intercept.

c.



d. The slope is $-\frac{3}{2}$. The equation is $y = 3 - \frac{3}{2}x$.

e.



$[-10, 10, 1, -10, 10, 1]$

The two lines are the same, so the equations are equivalent.

f.

$3x + 2y = 6$	Original equation.
$2y = 6 - 3x$	Subtract $3x$ from both sides.
$y = 3 - \frac{3}{2}x$	Divide both sides by 2.

11. a. -4.4 **b.** $y = -4.4 - 4.2(x - 2)$

c. -0.5 **d.** $y = 6.1 - 4.2(x + 0.5)$

e. Answers will vary. You could rewrite each equation in slope-intercept form. Both are equivalent to $y = 4 - 4.2x$.

f. The point $(4, -12)$ is not on the line; $(-3, 16.6)$ is on the line. Possible answer: Substitute the x- and y-values into the equation and check whether you get a true statement when you evaluate the equation. Or, substitute the given x-value into the equation, evaluate, and see whether it is equivalent to the given y-value.

12. a. The slope is $\frac{17.75 - 15.20}{23 - 20} = 0.85$. Using the point $(20, 15.20)$, we get the equation $y = 15.20 + 0.85(x - 20)$.

b. $y = 15.20 + 0.85(25 - 20)$; \$19.45

c. The equation is used to model the bill only when she is logged on for more than 15 h. Substituting 15 for x gives the flat rate of \$10.95 for all amounts of time less than or equal to 15 h.

d. Solve $23.70 = 15.20 + 0.85(x - 20)$: $x = 30$. So Dorine was logged on for 30 h.

13. **a.** Answers will vary depending on which point students use. Possible equations are $y = 568 + 4.6(x - 5)$, $y = 591 + 4.6(x - 10)$, $y = 614 + 4.6(x - 15)$, and $y = 637 + 4.6(x - 20)$.

b. $y = 545 + 4.6x$

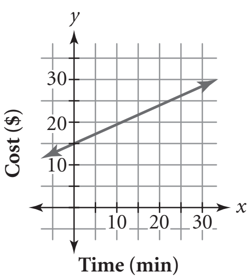
c. The slope represents the number of calories burned per minute. The y-intercept represents the number of calories Avery burned from the time she went to sleep Friday night until she started hiking.

d. Yes; it is equivalent to the slope-intercept equation $y = 545 + 4.6x$.

e. The point (60, 821) tells you that if Avery hikes for 60 minutes, she will have burned a total of 821 calories since she went to sleep Friday night.

14. **a.** One point on the line is (0, 15); other answers are possible. The slope is \$0.45/min.

b. $y = 15 + 0.45x$

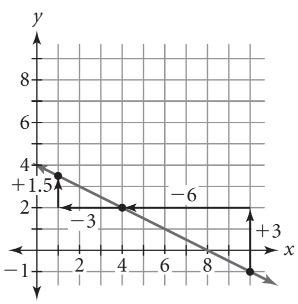


c. The line will be parallel to the original line, but 5 units higher.

d. The line will be parallel to the original line, but 15 units lower (passing through the origin).

e. The line will be steeper than the original line, but will have the same y-intercept.

15. **a.** This graph shows the slope triangles for 15a and 15b:



$$\frac{\textit{change in } y}{\textit{change in } x} = \frac{1.5}{-3} = -0.5$$

b. $$\frac{\textit{change in } y}{\textit{change in } x} = \frac{3}{-6} = -0.5$$

c. The sides of the slope triangle for 15b are twice as long, but the slopes are equal.

d. You would get a larger triangle with side lengths in the same ratio and the same slope.

16. $z = \dfrac{3.8 + 5.4}{0.2} - 6.2$; $z = 39.8$

LESSON 4.5

EXERCISES

1. **a.** $y = 1 + 2(x - 1)$ or $y = 5 + 2(x - 3)$

b. $y = 3 + \frac{2}{3}(x - 1)$ or $y = 5 + \frac{2}{3}(x - 4)$

c. $y = 6 - \frac{4}{3}(x - 1)$ or $y = 2 - \frac{4}{3}(x - 4)$

2. Estimates will vary. The answers show the equations in intercept form.

a. $y = -1 + 2x$

b. $y = \frac{7}{3} + \frac{2}{3}x$, or $y = 2.\overline{3} + 0.\overline{6}x$

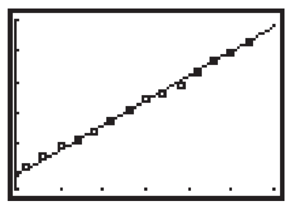
c. $y = \frac{22}{3} - \frac{4}{3}x$, or $y = 7.\overline{3} - 1.\overline{3}x$

3. **a.** 3 **b.** -4 **c.** 6

The x-intercept of $y = b(x - x_1)$ is x_1.

4. **a.** Answers will vary. Using the points (1982, 341) and (1996, 363) gives the equation $y = 341 + 1.6(x - 1982)$, where x is the year and y is the concentration of CO_2 in ppm.

b. Answers will vary, but all graphs should look approximately like this:



[1975, 2005, 5, 325, 380, 10]

c. Answers will vary. The equation $y = 341 + 1.6(x - 1982)$ gives 402 ppm.

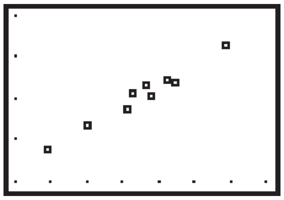
d. Answers will vary. Using the equation in 4a gives an x-intercept of about 1769. This value is found by substituting 0 for y in the equation $y = 341 + 1.6(x - 1982)$ and solving for x:

$$0 = 341 + 1.6(x - 1982)$$
$$-341 = 1.6(x - 1982)$$
$$\frac{-341}{1.6} = x - 1982$$
$$x = \frac{-341}{1.6} + 1982 \approx 1769$$

This x-intercept represents the year when the concentration of CO_2 would have been 0 ppm. This does not make sense because plants depend on CO_2, so there has been some concentration of CO_2 as long as there have been plants. The model is limited; it cannot be extended much before or after the time period of the data.

e. The slope represents the average rate of change, so the typical change in CO_2 concentration is about 1.6 ppm per year.

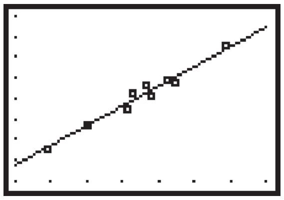
5. a.



[10, 45, 5, 40, 120, 10]

b. Answers will vary. Using the points (20, 67) and (31.2, 88.6) gives a slope of approximately 1.9, and a possible equation is $y = 67 + 1.9(x - 20)$.

c. One possible answer:

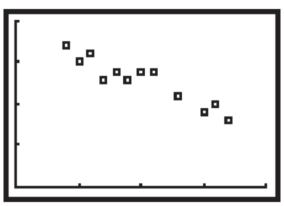


d. The slope is $\frac{212 - 32}{100 - 0}$, or 1.8. The possible equations are $y = 32 + 1.8(x - 0)$ and $y = 212 + 1.8(x - 100)$.

e. Answers will vary. The sample equation in 5b gives $y = 29 + 1.9x$. The equations in 5d both give $y = 32 + 1.8x$. The equations are not equivalent.

f. It is possible, but the difference could also be the result of measurement error or faulty procedures.

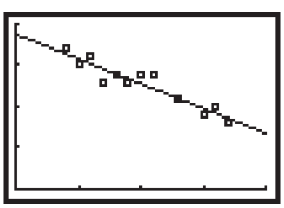
6. a.



[0, 20, 5, 0, 20, 5]

b. Answers will vary. Using (13, 11) and (8, 14), we get the equation $y = 11 - 0.6(x - 13)$ or $y = 14 - 0.6(x - 8)$.

c. Answers will vary. Here is the graph of the equation in 6b:



d. Answers will vary. Using $y = 11 - 0.6(x - 13)$ gives a concentration of dissolved oxygen of 17.6 ppm.

e. Answers will vary. Solving $12 = 11 - 0.6(x - 13)$ gives a temperature of about 11.3°C.

7. a. Using the point (11, 14) and the slope -0.6, the equation is $y = 14 - 0.6(x - 11)$.

b. Using the point (7, 13) and the slope -0.6, the equation is $y = 13 - 0.6(x - 7)$.

c. First equation (from Exercise 6):

$y = 11 - 0.6(x - 13)$

$y = 11 - 0.6x + 7.8$

$y = 18.8 - 0.6x$

Second equation:

$y = 14 - 0.6(x - 11)$

$y = 14 - 0.6x + 6.6$

$y = 20.6 - 0.6x$

Third equation:

$y = 13 - 0.6(x - 7)$

$y = 13 - 0.6x + 4.2$

$y = 17.2 - 0.6x$

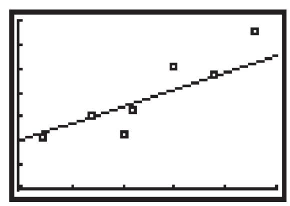
d. The equation has prediction accuracy within 1.8 ppm.

8. a. First find the slope of the line:

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{30 - 47}{67 - 79} = \frac{-17}{-12} \approx 1.4$$

Using the point (67, 30) and the slope 1.4, the equation is $y = 30 + 1.4(x - 67)$.

b.

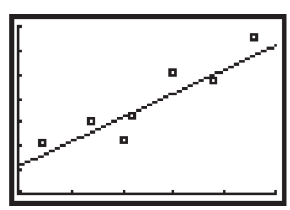


[60, 85, 5, 0, 70, 10]

c. Equations will vary. The graph with a larger y_1-value is parallel but higher, and the graph with a smaller y_1-value is parallel but lower.

d. Equations will vary. The graphs pass through point (67, 30), but the one with a larger value of b is steeper, and the one with a smaller value of b is less steep.

e. Possible equation: $y = 26 + 2(x - 67)$



[60, 85, 5, 0, 70, 10]

9. a. The number of biscuits decreases by 3 each day, so the slope is -3.

b. Using the point (10, 106) and slope -3, we find the equation $y = 106 - 3(x - 10)$.

c. The box will be empty on the 46th day. You can find this by solving the equation $y = 106 - 3(x - 10)$ or by reasoning that it will take 36 days to eat the 106 biscuits that remain in the box. Because there were 106 biscuits on the 10th day, it takes a total of $36 + 10$ or 46 days to finish the box.

d. The y-intercept, 136, is the number of biscuits that were in the box when it was new.

10.

Description	Undo	Equation
Pick y.		$y = \frac{12 - 2x}{-3} - 1$, or $y = -5 + \frac{2x}{3}$
$+1$	-1	$y + 1 = \frac{12 - 2x}{-3}$, or $y + 1 = -4 + \frac{2x}{3}$
$\cdot(-3)$	$/(-3)$	$-3(y + 1) = 12 - 2x$
$+2x$	$-2x$	$2x - 3(y + 1) = 12$

11. a.

$\frac{1}{10}t + \frac{1}{8}t = 1$	Original equation.
$\frac{4}{40}t + \frac{5}{40}t = 1$	Change fractions to have a common denominator.
$\frac{9}{40}t = 1$	Add fractions.
$9t = 40$	Multiply by 40 to undo the division.
$t = \frac{40}{9}$	Divide by 9 to undo the multiplication.

$t = 4.\overline{4}$, or about 4 h 27 min

b. Let t represent the number of minutes the bathtub is filling (and draining).

$\frac{1}{30}t - \frac{1}{45}t = 1$	Original equation.
$\frac{3}{90}t - \frac{2}{90}t = 1$	Find a common denominator.
$\frac{1}{90}t = 1$	Subtract.
$t = 90$	Multiply by 90 to undo the division.

It takes 90 minutes to fill the tub.

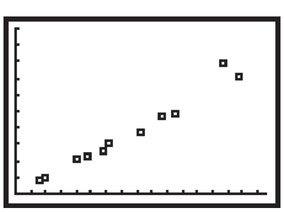
LESSON 4.6

EXERCISES

1. a. 166, 405, 623, 1052, 1483

b. 204, 514, 756, 1194, 1991

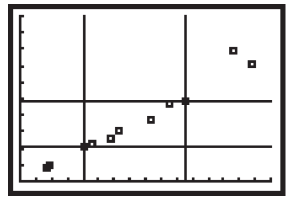
c.



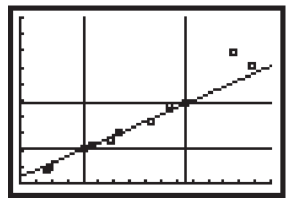
[0, 1650, 100, 0, 2500, 250]

d. The slope will be positive because as the flying distance increases so does the driving distance.

e. To make the rectangle, draw the vertical lines $x = 405$ and $x = 1052$, and the horizontal lines $y = 514$ and $y = 1194$. The Q-points are (405, 514) and (1052, 1194).



f. The slope is approximately 1.05. The equation is $y = 1194 + 1.05(x - 1052)$ or $y = 514 + 1.05(x - 405)$.



g. About 1054 miles; you can find this by substituting 919 for x in the equation or by tracing the graph.

h. About 535 miles; you can find this by substituting 651 for y in the equation and solving for x or by tracing the graph.

2. a. $y = 10 + 0.5(32 - 28)$; 12 grams of saturated fat

b. $15 = 10 + 0.5(x - 28)$

$5 = 0.5x - 14$

$19 = 0.5x$

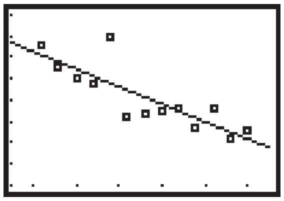
$38 = x$; 38 grams of fat

3. a. For the x-values: Q1 = 5, Q3 = 10
For the y-values: Q1 = 4, Q3 = 9
Use a graph to see that the Q-points are (5, 4) and (10, 9).

b. For the x-values: Q1 = 3, Q3 = 8
For the y-values: Q1 = 2, Q3 = 8
Use a graph to see that the Q-points are (3, 8) and (8, 2).

4. a. Let x represent years, and let y represent winning time in minutes. The five-number summary for x is 1952, 1962, 1976, 1990, 2000. The five-number summary for y is 27.12, 27.5, 27.78, 28.65, 29.46. The Q-points are (1962, 28.65) and (1990, 27.5). The slope of the line through these two points is about -0.0411, so the possible equations are $y = 28.65 - 0.0411(x - 1962)$ and $y = 27.5 - 0.0411(x - 1990)$.

b.



[1945, 2005, 10, 26, 30, 0.5]

c. The slope, -0.0411, means that the winning time decreases an average of 0.0411 min (2.47 s) each year.

d. The prediction is 26.92 min, which is 0.16 min (9.6 s) less than the actual winning time.

e. Answers will vary. However, there is a physical limit to how fast a person can run. Eventually the times will have to level off.

5. Answers will vary. Q1 and Q3 for the x-values should be 4 and 12, respectively, and Q1 and Q3 for the y-values should be 28 and 47, respectively. If we create a data set with seven values, the quartiles will be the second and sixth values. The x-values can be 2, 4, 6, 8, 10, 12, 14. The y-values can be 22, 28, 30, 35, 42, 47, 53. Now we have to match up the x- and y-values so that one of the Q-points, say (12, 47), is in the data set and the other is not. One possible pairing is {(2, 22) (4, 30) (6, 28) (8, 35) (10, 42) (12, 47) (14, 53)}.

6. iv. Possible explanation: The y-values decrease as the x-values increase, so the slope of the line of fit must be negative, which narrows the choices to iii and iv. If you fit a line to the data using Q-points, the Q-points would be (11, 1.3) and (6, 2.2). The slope of the line through these points is -0.18. Equation iv is the equation of the line through these Q-points, so it is the best fit.

7. a. The Q-points for this data set are (4, 1.3) and (12, 6.3). The slope of the line through these points is 0.625, so the equation is $y = 1.3 + 0.625(x - 4)$ or $y = 6.3 + 0.625(x - 12)$.

b. The elevator is rising at a rate of 0.625 second per floor.

c. Substituting 60 for x gives a y-value of 36.3. So the elevator passes the 60th floor at 36.3 seconds after 2:00, or approximately 2:00:36.

d. Substituting 45 for y and solving gives an x-value of 73.92, so the elevator will be almost at the 74th floor.

8. a. The Q-points for this data set are (92, 1.3) and (84, 6.3). The slope of the line through these points is -0.625, so the equation is $y = 1.3 - 0.625(x - 92)$ or $y = 6.3 - 0.625(x - 84)$.

b. The elevator is moving down at a rate of 0.625 second per floor.

c. Substituting 10 for x gives a y-value of 52.55. So the elevator passes the 10th floor after 52.55 seconds, or at approximately 2:00:53.

d. Substituting 34 for y and solving gives an x-value of 39.68, so the elevator will be between the 39th and 40th floors.

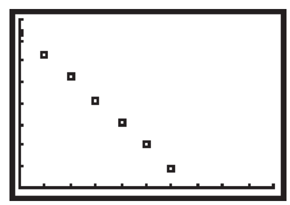
9. a. Answers will vary.

b. At 28.8 s, or at about 2:00:29, the elevators will pass at the 48th floor. One way to find this answer is to make a calculator table of both $y = 1.3 + 0.625(x - 4)$ and $y = 1.3 - 0.625(x - 92)$. When x is 48, the y-value for both equations is 28.8.

10. a. {0, 370} ENTER,
{Ans(1) + 1, Ans(2) − 54} ENTER, ENTER, . . .

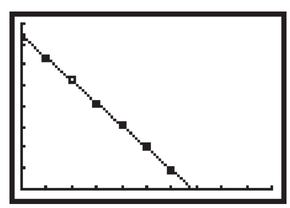
Time (h)	Distance from Mt. Rushmore (mi)
0	370
1	316
2	262
3	208
4	154
5	100
6	46

b.



[0, 10, 1, 0, 400, 50]

c.



The line represents the distance from Mt. Rushmore at any time during the trip. The line lets you find the distance at any time; the points show the distance only at 1-hour intervals.

d. The slope is -54, which means that the distance from Mt. Rushmore decreases by 54 miles each hour.

e. The car will reach the Wall Drug Store after about 5.4 hours, or about 5 hours 24 minutes. You can find this by solving the equation $80 = 370 - 54x$ or by finding the x-value on the graph corresponding to the y-value 80.

f. The car will reach Mt. Rushmore in just under 7 hours. You can find this answer by solving the equation $0 = 370 - 54x$ or by finding the x-value on the graph corresponding to the y-value 0.

11. The size and cost are almost directly proportional. The 4 oz bottle costs \$0.22 per oz, the 7.5 oz bottle costs \$0.22 per oz, and the 18 oz bottle costs \$0.2217 per oz. If you change the price of the 18 oz bottle to \$3.96, then it also will cost exactly \$0.22 per oz.

12. Answers will vary. Sample answer: To convert an equation from point-slope form to slope-intercept form, use the distributive property and then simplify. For example, to convert the equation $y = 4 + 2(x - 3)$ to slope-intercept form, use the distributive property to rewrite it as $y = 4 + 2x - 6$. Then simplify the equation and write it in the form $y = mx + b$. You get $y = 2x - 2$. You can check that the equations are equivalent by making a graph or a table. If the equations are equivalent, the graphs will be identical and the values in the table will be equal.

LESSON 4.7

EXERCISES

1. a. $(6, 6)$

b. $(5, 9)$

c. $y = 9 - 3(x - 5)$

d. $y = 24 - 3x$

e. $(8, 0)$

2. a. $x = 10$

b. $x = -7.5$

c. $x = 2.5$

d. $x = 41.5$

3. a.

$2x + 5y = 18$	Original equation.
$5y = 18 - 2x$	Subtract $2x$ from both sides.
$y = \dfrac{18 - 2x}{5}$	Divide both sides by 5.
or $y = 3.6 - 0.4x$	

b.

$5x - 2y = -12$	Original equation.
$-2y = -12 - 5x$	Subtract $5x$ from both sides.
$y = \dfrac{-12 - 5x}{-2}$	Divide both sides by -2.
$y = \dfrac{12 - 5x}{2}$,	
or $y = 6 + 2.5x$	

4. a. Let x represent years, and let y represent distance in meters. The Q-points are (1964, 61.00) and (1992, 68.82). The slope of the line through these points is about 0.28, so the equation is $y = 61.00 + 0.28(x - 1964)$ or $y = 68.82 + 0.28(x - 1992)$. The slope, 0.28, means that the winning distance increases an average of 0.28 m, or 28 cm, each year. The y-intercept, -489 m, is meaningless in this situation because it would indicate that a negative distance was the winning distance in year 0. The model cannot predict that far from the data range.

b. Using the equation $y = 61.00 + 0.28(x - 1964)$ with $x = 1912$ gives 46.44 m. The predicted distance is 1.23 m more than the actual distance of 45.21 m.

c. To find the year using the equation $y = 61.00 + 0.28(x - 1964)$, solve $80 = 61.00 + 0.28(x - 1964)$.

$80 = 61.00 + 0.28(x - 1964)$	Original equation.
$19.00 = 0.28(x - 1964)$	Subtract 61.00 from both sides.
$67.86 \approx x - 1964$	Divide both sides by 0.28.
$2032 \approx x$	Add 1964 to both sides and round off.

The model predicts that the winning distance will pass 80 m in the 2032 Summer Olympics.

5. a. Let x represent the distance from Los Angeles in miles, and let y represent elapsed time in minutes. The Q-points are (411.5, 1439) and (1181.5, 273). The slope of the line through these points is about -1.51, so the equation is $y = 1439 - 1.51(x - 411.5)$ or $y = 273 - 1.51(x - 1181.5)$. The slope means that the elapsed time increases 1.51 minutes each time the distance decreases by 1 mile.

b. Approximately 1758 min, or 29 h 18 min, by the first equation, or approximately 1755 min, or 29 h 15 min, by the second equation.

c. You can find this by solving $600 = 1439 - 1.51(x - 411.5)$ or $600 = 273 - 1.51(x - 1181.5)$. The first equation gives about 967 mi, and the second gives about 965 mi. Here is the solution for the first equation:

$600 = 1439 - 1.51(x - 411.5)$	Original equation.
$-839 = -1.51(x - 411.5)$	Subtract 1439 from both sides.
$555.6 \approx x - 411.5$	Divide both sides by -1.51.
$967.1 \approx x$	Add 411.5 to both sides.

You are about 967 mi from Los Angeles.

6. a. $4t + 6\left(t - \frac{1}{2}\right) = 7$

b.

$4t + 6\left(t - \frac{1}{2}\right) = 7$	Original equation.
$4t + 6t - 3 = 7$	Distributive property.
$10t - 3 = 7$	Add.
$10t = 10$	Add 3 to undo the subtraction.
$t = 1$	Divide by 10 to undo the multiplication.

Check: $4(1) + 6\left(1 - \frac{1}{2}\right) \stackrel{?}{=} 7$

$4 + 6(0.5) \stackrel{?}{=} 7$

$4 + 3 \stackrel{?}{=} 7$

$7 = 7$

Ellen jogged for 1 h and Eric jogged for $\frac{1}{2}$ h.

c. Let r represent the rate of the propeller airplane in km/h. Then $5r$ is the rate of the jet airplane.

$2.25(5r) - 2.25r = 1170$	Original equation.
$11.25r - 2.25r = 1170$	Multiply.
$9r = 1170$	Subtract.
$r = 130$	Divide by 9.

The velocity of the propeller airplane is 130 km/h; the velocity of the jet airplane is 5(130), or 650 km/h.

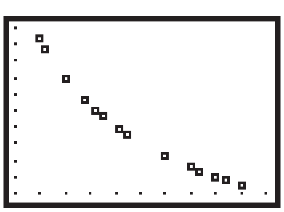
7. $\frac{50 \text{ grains}}{3.24 \text{ grams}} = \frac{x \text{ grains}}{1 \text{ gram}}$; 15.4321 grains per gram

8. The balance illustrates the equation $4x + 2 = x + 7$.

$4x + 2 = x + 7$	Original equation.
$4x - x + 2 = x - x + 7$	Subtract x from both sides.
$3x + 2 = 7$	Combine like terms.
$3x + 2 - 2 = 7 - 2$	Subtract 2 from both sides.
$3x = 5$	Combine like terms.
$\frac{3x}{3} = \frac{5}{3}$	Divide both sides by 3.
$x = \frac{5}{3}$, or $1.\overline{6}$	Reduce.

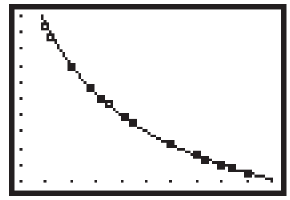
Improving Your Reasoning Skills

Here is a scatter plot of the data:



[20, 70, 5, 50, 150, 10]

This is the graph of an inverse variation, so the equation should be in the form $xy = k$ or $y = \frac{k}{x}$, where k is a constant. To find k, you can find the product of each pair of x- and y-values and calculate the mean. This gives $k = 3599.51 \approx 3600$, so the equation is $y = \frac{3600}{x}$. This equation fits the points very well.



To predict the time a driver traveling 45 mi/h would need for the trip, substitute 45 for x. The result is about 80 min. To find the travel speed required to complete the trip in 70 min, substitute 70 for y and solve for x. The result is about 51.4 mi/h.

LESSON 4.8

Activity day: There are no answers for this lesson.

CHAPTER 4 Review

Exercises

1. $-3 = \frac{4 - 10}{x_2 - 2}$

$-3(x_2 - 2) = -6$

$x_2 - 2 = 2$

$x_2 = 4$

2. a. Slope: -3; y-intercept: -4

b. Slope: 2; y-intercept: 7

c. Slope: 3.8; y-intercept: -2.4

3. Line a has slope -1, y-intercept 1, and equation $y = 1 - x$.

Line b has slope 2, y-intercept -2, and equation $y = -2 + 2x$.

4. a.

$y = 13.6(x - 1902) + 158.2$	Original equation.
$y = 13.6x - 25{,}867.2 + 158.2$	Distribute the 13.6.
$y = 13.6x - 25{,}709$	Add.

b. The y-coordinate of the point with x-coordinate 10 is -37. Using slope -5.2 and the point $(10, -37)$, you get the equation $y = -37 - 5.2(x - 10)$.

5. a. $(-4.5, -3.5)$

b. $y = 2x + 5.5$

c. $y = 2(x + 2.75)$; the x-intercept is -2.75.

d. The x-coordinate is 5.5. The equation is $y = 16.5 + 2(x - 5.5)$.

e. Answers will vary. Possible methods are graphing, using a calculator table, and putting all equations in intercept form.

6. a. $4 + 2.8x = 51$

$$2.8x = 47$$
$$x \approx 16.8$$

b. $38 - 0.35x = 27$

$$-0.35x = -11$$
$$x \approx 31.4$$

c. $11 + 3(x - 8) = 41$

$$3(x - 8) = 30$$
$$x - 8 = 10$$
$$x = 18$$

d. $220 - 12.5(x - 6) = 470$

$$-12.5(x - 6) = 250$$
$$x - 6 = -20$$
$$x = -14$$

7. a. $y = 12{,}600 - 1{,}350x$

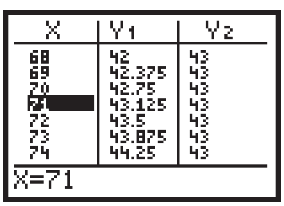
b. The slope is $-1{,}350$; the car's value decreases by \$1,350 each year.

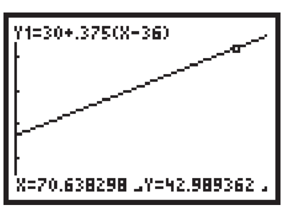
c. The y-intercept is 12,600; Karl paid \$12,600 for the car.

d. The x-intercept is $9\frac{1}{3}$; in $9\frac{1}{3}$ years, the car will have no monetary value.

8. a. $43 = 30 + 0.375(x - 36)$

b. $x \approx 71$ s





[0, 80, 10, 0, 50, 10]

c. $43 = 30 + 0.375(x - 36)$

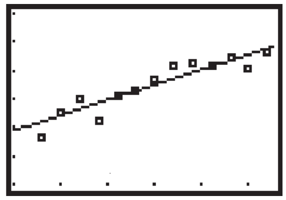
$$13 = 0.375(x - 36)$$
$$34.\overline{6} = x - 36$$
$$70.\overline{6} = x$$

9. a. 1956, 1966, 1980, 1994, 2004; 1.76, 1.875, 1.97, 2.025, 2.06

b. The Q-points are (1966, 1.875) and (1994, 2.025).

c. $y = 1.875 + 0.00536(x - 1966)$ or $y = 2.025 + 0.00536(x - 1994)$

d. Answers will vary. There are more points above the line than below the line.



[1950, 2005, 10, 1.6, 2.2, 0.1]

e. Using $y = 1.875 + 0.00536(x - 1966)$, the predicted winning height for the year 2012 is 2.12 m.

10. a. $y = 2.25 + 0.13(x - 1976.5)$ or $y = 4.025 + 0.13(x - 1990.5)$

b. The slope means that the minimum hourly wage increased about \$0.13 per year.

c. Using $y = 2.25 + 0.13(x - 1976.5)$ with $x = 2010$ gives the prediction \$6.61; using the equation $y = 4.025 + 0.13(x - 1990.5)$ gives the prediction \$6.56.

d. Using $y = 2.25 + 0.13(x - 1976.5)$ with $y = 1.00$ gives the prediction 1967.

11. a. The equation is $y = a + bx$, where b is the slope and a is the y-intercept.

b. Use the points to find the slope. If the points are (x_1, y_1) and (x_2, y_2), then the slope is $\frac{y_2 - y_1}{x_2 - x_1} = b$. Use the slope and one of the points to write the equation. Using the point (x_1, y_1) gives the equation $y = y_1 + b(x - x_1)$.

Take another look

The rate of change of a curve (other than a straight line) is not constant. In general, you can't find the slope of a curve at a point by finding the slope of a line between two points on the curve, no matter how close together those points are. The average rate of change over the x-interval from 3 to 3.25 is not the same as from 3.25 to 3.5.

The average rate of change between the points (8, 1.5) and (8.5, 1.4) is -0.2. The average rate of change between (3, 4) and (3.5, 3.4) is -1.2. This tells us that the rate of change of the y-values is slower on the "wings" of the curve than at the portion of the graph nearest the origin.

The equation of the line through the points (8, 1.5) and (8.5, 1.4) is $y = 1.5 - 0.2(x - 8)$.